NEW JERSEY DEPARTMENT OF HEALTH AND SENIOR SERVICES

Occupational Health Surveillance Update

SPECIAL ISSUE ON LEAD

James E. McGreevey
Governor

Clifton R. Lacy, M.D.
Commissioner

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Division of Epidemiology, Environmental and Occupational Health

Trends in Adult Blood Lead Levels in New Jersey -- 1986-2000

Occupational lead toxicity is a public health problem that has been persistent for decades. The National Institute for Occupational Safety and Health (NIOSH) has led a nationwide effort to prevent occupational lead toxicity by providing capacity building funds to establish Adult Blood Lead Epidemiology and Surveillance (ABLES) programs. A total of 35 states now have ABLES programs.

In October 1985, the New Jersey Department of Health and Senior Services (DHSS) - Occupational Health Surveillance (OHS) Program established a surveillance system to identify workers with elevated blood lead levels (BLL) and workplaces where exposure to lead was occurring. Funding under the NIOSH ABLES Program began in 1994.

Worker removing lead paint from a water tower using the high-pressure water jet method.

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Inside . . .

New Jersey Companies Who Have "Dropped Out"

What does it mean when a company no longer appears in the Lead Registry? Have they stopped using lead? Have they been successful in eliminating lead exposure in the workplace? Is the company no longer in business? Of greater concern, is there a problem with the lead surveillance reporting system? To answer these questions, the New Jersey ABLES program conducted a mailed survey to find out what happened to these "dropped out" lead-using workplaces. Surveys were sent to all companies in the Lead Registry that have not been reported to the ABLES system for two consecutive years. The *Lead Update Survey* collected information on current business activities and requested data on current lead use, air sampling for lead, and employee biological monitoring for lead in blood. The most recent survey was conducted in March, 2001 to 123 "dropped out"

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Perspectives on Lead in the Workplace

Special Interviews

While New Jersey and other states are reporting downward trends in adult blood lead levels, lead poisoning persists as an occupational health problem. I asked Steven Marcus, M.D., and David Ippolito to share with us their perspectives on occupational lead issues at the threshold of this new millennium. Dr. Marcus is board-certified in toxicology and a recognized expert in the field of lead toxicity. He is the director of the New Jersey Poison Information and Education System (NJPIES). Mr. Ippolito has been the director of the Parsippany OSHA Area Office since 1997. Under his leadership, this office has implemented many innovative projects in the area of worker protection. — Helga Fontus

Q: *What role does NJPIES play in preventing lead toxicity?*
Marcus: NJPIES fields questions from workers, families, and friends of individuals either defined as at risk or who identify themselves as possibly at risk. We discuss prevention techniques and stress the need for medical follow-up for those who have been identified with lead poisoning. We have an educational website, *www.njpies.org,* intended for children exposed to lead, which is useful for adults as well. Staff at NJPIES are available to evaluate individuals, at their request, to manage their lead poisoning.

Steven M. Marcus, M.D.
Director
New Jersey Poison Information and Education System (NJPIES)
Newark, New Jersey

Q: *What trends have you seen in adult lead cases at NJPIES over the last ten years?*
Marcus: The requests for information or clinical consultations have decreased over the years. We hope that reflects a decrease in covert cases, not an increase. For example, the lead-exposed "healthy worker" is often asymptomatic and doesn't seek medical care unless he or she feels sick. In the past, we dealt with many of the bridge workers involved with repairs of structural steel in New Jersey. The changes in the contract wording that include safety and health provisions from the New Jersey Department of Transportation, hopefully, has decreased the number of construction workers with lead poisoning. The number of individuals involved in lead smelting also seems to have decreased.

Recently, we have seen a number of individuals involved in residential house remodeling who have had very high blood lead levels (BLLs). I do believe that this profession will soon become the most commonly seen with lead poisoning. This is particularly true in a state such as New Jersey in which over one-third of the homes were built prior to 1978 and are, thus, painted with lead-based paint.

Q: *What is the role of the clinician in preventing occupational lead toxicity in New Jersey?*
Marcus: Primary prevention (i.e., elimination of lead exposure) remains the responsibility of the employer who also must inform the employee of the dangers of lead exposure. The clinician can become involved in secondary and tertiary prevention through efforts to understand how a specific worker became exposed, search for others with similar potential exposures, and help the employer remove the threat to other workers. Also, physicians are required by New Jersey statute to report every individual with a BLL equal to or greater than 25 micrograms per deciliter (µg/dl) to the State Department of Health and Senior Services. This allows the Department to conduct the appropriate case and workplace follow-up so exposure of co-workers can be evaluated.

Q: *What would you recommend as an approach for the clinician who sees a worker with an elevated blood lead level?*
Marcus: The clinician must take a thorough medical and work history and look for subtle signs of impairment, such as defects in sexual performance, mood swings, hypertension, etc. In addition, basic laboratory evaluation should include evaluation of iron stores, end organ (kidney, liver) damage, as well as covert gout (uric acid determination). A blood zinc protoporphyrin (ZPP) level may give some indication of the chronicity of the exposure. Removal of the worker from the source of lead is paramount to the treatment.

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David Ippolito
Director
U.S. Department of Labor OSHA - Parsippany Area Office
Parsippany, New Jersey

Q: *What role do the OSHA Area Offices play in preventing lead poisoning in New Jersey?*
Ippolito: There are four OSHA area offices that cover New Jersey: Avenel, Hasbrouck Heights, Marlton, and Parsippany. The office addresses, and counties covered by each office, are as follows:

• AVENEL
Plaza 35, Suite 205, 1030 St, Georges Ave., Avenel, NJ 07001
Telephone: (732) 750-3270
Hunterdon, Middlesex, Somerset, Union, Warren, and Staten Island

• HASBROUCK HEIGHTS
500 Rt. 17 South, 2nd Floor, Hasbrouck Heights, NJ 07604
Telephone: (201) 288-1700
Bergen and Passaic

• MARLTON
Building 2, Suite 120, 170 Route 73 South, Marlton, NJ 08053
Telephone: (856) 757-5181
Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Monmouth, Ocean, and Salem

• PARSIPPANY
299 Cherry Hill Rd., Rm. 304, Parsippany, NJ 07054
Telephone: (973) 263-1003
Essex, Hudson, Morris, and Sussex.

Each Area Office responds to complaints and referrals concerning occupational exposure to lead within its own jurisdiction. A complaint is a notice of alleged hazardous conditions filed by an employee, the employee's immediate family, or the employee's elected or designated representative. A referral is a notice of alleged hazardous conditions received, usually, from another governmental entity such as the New Jersey Department of Health and Senior Services (DHSS).

Additionally, each Office performs planned inspections in accordance with OSHA's Local Emphasis Programs, Strategic Site Planning, National Emphasis Programs and Strategic Initiatives. As part of its 5-year strategic plan, OSHA has identified lead as one of the toxic substances for specific educational and enforcement efforts nationwide. The primary goal of OSHA's Strategic Plan is to improve workplace safety and health for all workers, as evidenced by fewer hazards, reduced exposures, and fewer injuries, illnesses, and fatalities. Under this goal, the Agency has committed to "reduce three of the most prevalent types of workplace injuries and illnesses by 15% by focusing on those industries and occupations that cause the most injuries/illnesses and pose the greatest risk to workers." To achieve this goal, the Agency has focused on reducing amputations, and the health hazards of silica and lead exposures.

Specifically, a National Emphasis Program (NEP) has been in effect since 1996 to reduce lead exposure in the construction industry. This year, OSHA expanded that emphasis to include all lead exposures regardless of their origin. OSHA's National Emphasis Programs are described on its web site (www.osha.gov).

I want to emphasize that OSHA enforces its standards to prevent excessive lead exposure in *workers*, not in the general public. OSHA bases its exposure levels on lead exposures received on the job, with the assumption that workers are not receiving additional exposures to lead off the job. This allows for higher permissible exposures for workers than for the general public. OSHA standards therefore should not be compared to what would be allowable exposure for the general public.

The standards enforced by OSHA during its lead inspections are comprehensive in nature. In addition to ensuring that employees are not exposed to airborne lead in excess of 50 micrograms per cubic meter ($\mu g/m^3$) measured as an 8-hour time weighted average, the standards address personal hygiene, respiratory protection, medical surveillance, protective clothing, medical removal, engineering controls, and recordkeeping. The 50 $\mu g/m^3$ standard is the same for both the construction and general industries. This means that a worker cannot be exposed to airborne lead in excess of 50 $\mu g/m^3$ averaged over 8 hours. Both standards also have a 30 $\mu g/m^3$ "action level." The action level requires the employer to take steps to ensure that employees are provided with proactive protection such as medical surveillance, training and periodic air monitoring.

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Outcomes of Interventions to Prevent Lead Toxicity New Jersey, 1997-2000

Although reducing lead exposure remains the focus of the New Jersey ABLES program, new cases and workplaces are identified each year. Worker, physician, and workplace follow-ups take place according to the specified protocols described below. However, because of limited resources, priority is given to individuals who are reported with blood lead levels (BLLs) greater than or equal (≥) to 40 micrograms per deciliter (µg/dl).

Worker

PROTOCOL: Worker follow-up begins with the mailing of a contact letter and educational materials to all reported individuals. In addition, all reachable workers reported with a BLL ≥ 40 µg/dl are interviewed by telephone. The purpose of the interview is to ensure that the individual is informed about lead hazards, prevention of lead exposure, and appropriate medical care. The source of exposure is also identified. Individuals who cannot be reached by telephone receive a mailed, self-administered questionnaire. Information collected from phone interviews and self-administered questionnaires for workers reported from 1997-2000 with BLL ≥ 40 µg/dl is summarized below. Individuals who have small children also receive information on the hazards of lead dust brought home from work. In addition, individuals with elevated BLLs that are determined to be occurring from non-occupational sources are provided with appropriate educational materials and referred to their personal physicians.

Source of Data: worker phone interviews and self-administered questionnaires, 1997-2000
Source of Exposure: occupational
Population: individuals reported with BLL ≥ 40 µg/dl

OUTCOMES:

- *Ninety-eight individuals were interviewed by telephone and 21 individuals completed a self-administered questionnaire;*
- *Among 119 individuals, 10 (8%) were females;*
- *Fifty-five (46%) were from the construction industry, 27 (23%) from electronic and other electrical equipment industries, and 13 (11%) from primary metals; the remaining 24 worked in other industries;*
- *The 55 construction workers were involved in trades such as painters, structural metal workers, carpenters, and laborers;*
- *Among the non-construction industries, major occupational groups represented were: machine operators such as grinding, polishing, molding, casting and furnace or kiln operators, mechanics and repairers, handlers, equipment cleaners, and laborers;*
- *Responding to specific questions, 70 (69%) reported the use of ventilation to control dust and fumes; 72 (71%) reported using a respirator; and 81 (80%) reported that the workplace was dusty. In terms of hygiene practices: 63 (32%) said their employer provided uniforms, 46 (47%) reported that the uniforms were cleaned at work, 60 (59%) indicated the availability of shower facilities, and 67 (66%) reported that there was a separate eating area.*

Physician

PROTOCOL: A self-administered questionnaire and information on medical management of occupational lead toxicity are mailed to all physicians of individuals reported with BLL ≥50 µg/dl. The questionnaire contains questions regarding their type of medical specialty, relationship to the worker, medical follow-up conducted for the worker, and whether the physician visited the workplace of the reported individual and issued any recommendations to the employer. Physicians are provided consultations by DHSS upon request. A summary of data collected from physician questionnaires from 1997-2000 follows.

Source of Data: physician self-administered questionnaires, 1997-2000
Source of Exposure: occupational and non-occupational
Population: individuals reported with BLL ≥ 50 µg/dl

OUTCOMES:

- *Forty-two physicians returned self-administered questionnaires regarding 56 workers with BLL ≥ 50 µg/dl;*
- *Seven physicians specialized in occupational medicine, 15 in internal medicine, 15 in family practice/general practice, and five in other specialties;*
- *Four physicians visited the workplace of the worker;*
- *Thirty-five (83%) physicians made recommendations to the employer to modify working conditions.*

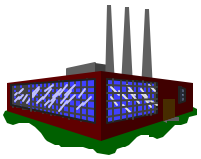
REMINDER

Physicians are required by law to report certain occupational diseases and injuries (N.J.A.C. 8:57-3.2)

For more information on reporting requirements or to obtain a copy of the *Occupational Disease and Injury Report for Physicians* form, call the Occupational Health Service at

(609) 984-1863

Employer



PROTOCOL: DHSS workplace follow-up occurs in three tiers: identification of new workplaces, industrial hygiene evaluations and consultations, and workplace referrals to Federal OSHA Region II Area Offices. Outcomes of DHSS interventions from 1997 to 2000 are summarized under each category.

TIER 1 ♦ ***Identification of New Workplaces***

Lead-using workplaces are identified from laboratory or physician reports of workers with BLL ≥ 25 µg/dl. All identified employers that are new to the ABLES system are interviewed by telephone to determine their awareness of the lead hazard that caused the individual to be exposed and to assess their knowledge of the OSHA lead standards. Employers are sent educational materials on lead hazard identification and control technologies, and on the OSHA lead standards.

Source of Data: case reports, employer (new to NJ ABLES) phone interviews,1997-2000
Source of Exposure: occupational
Population: individuals reported with BLL ≥ 25µg/dl

OUTCOMES:

- *Eighty-six New Jersey lead-using workplaces were newly identified; 73 (85%) interviews were completed.*
- *Forty-nine workplaces were from the construction industry, three from automotive repair and services, five from the stone, clay, and glass products industry, and four from scrap and waste materials; the remaining 25 belonged to other industries.*

TIER 2 ♦ ***Industrial Hygiene Evaluations and Consultations***

ABLES staff conduct a comprehensive evaluation of each workplace with workers who were reported with BLL ≥ 40 µg/dl. This evaluation includes review of data from employer and employee interviews, results of blood and air lead levels, OSHA investigation outcomes, and information on past and present DHSS intervention efforts. This review is conducted monthly. Workplaces are contacted if additional information is needed such as current air and/or blood lead levels.

ABLES staff analyze all the above information in order to devise the most effective intervention strategy. A variety of actions are implemented including the mailing of educational materials to employers on prevention of lead toxicity and industrial hygiene on-site evaluations. Each site visit is followed by a report containing findings and recommendations. The recommendations are tailored to target risk factors identified from the comprehensive evaluation and during the site visit. In additon, telephone and on-site technical consultations are provided to employers upon request.

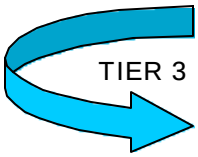
"Hands-on" demonstrations are also incorporated in DHSS on-site evaluations. These practical training sessions are tailored to each workplace. Some utilize videos and some use translators for non English-speaking workers. Others demonstrate to the worker the proper way to wear a respirator and the importance of practicing good

hygiene habits such as not eating at a workstation and not bringing lead dust to the lunch room or home. A question and answer period allows workers to address specific concerns.

Source of Data: DHSS industrial hygiene evaluations, 1997-2000
Source of Exposure: occupational
Population: workplaces with individuals reported with BLL ≥ 40µg/dl

OUTCOMES:

- *DHSS conducted 31 industrial hygiene on-site evaluations of workplaces with workers reported with BLL ≥ 40 µg/dl and issued recommendations;*
- *Approximately one-third of visited workplaces were in primary metals industries;*
- *Recommendations were provided on air and biological monitoring, respiratory protection, housekeeping, and hygiene facilities and practices.*



TIER 3 ♦ ***Workplace Referrals to Federal OSHA Region II Area Offices***

Workplaces may be referred to OSHA for enforcement of the provisions of the OSHA lead standards. This only applies to workplaces that are reported with workers with BLL ≥ 40 µg/dl. These referrals are made based on a Memorandum of Understanding (MOU) between DHSS and Federal OSHA Region II that covers New Jersey, New York, Puerto Rico, and the U.S. Virgin Islands. This MOU also allows for follow-up referrals for workplaces previously referred to OSHA and having workers with repeated BLLs ≥ 40 µg/dl.

Source of Data: OSHA, DHSS, 1997-2000
Source of Exposure: occupational
Population: workplaces with individuals reported with BLL ≥ 40µg/dl

OUTCOMES:

- *Twenty workplaces were referred to OSHA for the first time or as follow-up to a previous referral;*
- *Eleven referrals were in the construction industry; four in the primary metals industry; two in battery manufacturing industry; and one each in the durable goods, paper coating and metal foil and lead industries;*
- *OSHA visited and/or issued citations to 15 workplaces;*
- *A total of 48 lead standards-related citations were issued to these 15 companies;*
- *The citations were for exposing employees to levels of lead above the Permissible Exposure Limit (PEL), for not implementing engineering controls, not providing respirators and appropriate protective work clothing, and not maintaining surfaces free of lead dust.*

Barbara Gerwel *(barbara.gerwel @doh.state.nj.us)*

I have been the NJ ABLES Coordinator for 15 years. My first days with the project involved reviewing cases with very high blood lead levels (BLL) reported by Dr. Steven Marcus, Director of NJPIES. Since then, the welfare of these workers has become my main goal. Both BLLs of lead-exposed workers and the number of reported workers have gradually decreased over time. Our state faces a new challenge - to lower BLL below 25 µg/dl; a task that I proudly under-take with our dedicated ABLES staff.

Devendra Singh *(devendra.singh @doh.state.nj.us)*

I am a Certified Industrial Hygienist (CIH) in the ABLES program responsible for educational and intervention activities for lead workplaces. The best part of my job is that it allows me to interact with employees who work with lead on a daily basis. This provides me an opportunity to help make a difference at the 'grass roots' level. My personal goal is to know more about myself and I practice Yoga and meditation to help me remain on that path.

Marion Pearson *(marion.pearson @doh.state.nj.us)*

I have been involved with data management for ABLES since 1990. My primary responsibilities are compiling data from case surveys and laboratory reports. I also assist with quality control and statistical analysis. I take pride in having the opportunity to help New Jersey workers and employers minimize their exposure to lead. It has also been my pleasure to have worked with a great ABLES staff for so many years.

NEW JERSEY ABLES TEAM

From left: J. Johnson, D. Singh, B. Gerwel, R. Ramaprasad, M. Pearson, N. Heverin

Jaime Johnson *(jaime.johnson @doh.state.nj.us)*

I'm the latest addition to the ABLES team and have been designated to handle mailing of information and questionnaires to employees. It's rewarding knowing that in some small way I may be improving someone's life, by helping workers become aware of health hazards they face and to take actions regarding their health. I recently got married and I am the owner of two adorable Labrador retrievers and three frisky cats.

Rukmani Ramaprasad *(rukmani.ramaprasad@doh.state.nj.us)*

I have been working in the ABLES project since 1990. My main responsibilities are data management and data analysis. I find the challenges of maintaining data quality and operating with different software products to be stimulating. Data analysis is rewarding too - first through gaining insight on program aspects and second, sharing the same through publications and presentations. What else do I like? I enjoy Nature and love to travel.

Noreen Heverin *(noreen.heverin @doh.state.nj.us)*

I joined ABLES in 1994 where my primary role has been to conduct lead workplace interviews. If an employee has a blood lead level ≥ 25 µg/dl, I contact their employer to inquire about their use of lead and the employee's elevated blood lead level. My questionnaire asks about the source of lead exposure, biological monitoring, what programs are used to reduce lead exposure, and much more. I love spending time with my 4-year old granddaughter, Kira.

Q&A How Does Lead Exposure Occur Outside of Work?

Hobbies

- *Artistic painting* – some pigments contain lead
- *Ceramics/pottery making* – some glazes contain lead
- *Jewelry making* – some solders contain lead
- *Stained glass making* – some solders contain lead
- *Making fishline sinkers* – involves melting lead
- *Making ammunition* – involves melting lead
- *Restoring furniture* – may involve removing paint and varnishes that contain lead and sanding wood that has been stripped but still harbors small amounts of lead
- *Making wine in porcelain sink or tub* – some porcelains contain lead
- *Target practice* – some bullets create lead dust when fired

Painted Surfaces

Homes built before 1978 likely have been painted with paint that contains lead

- *Restoring woodwork* or *surface preparation for painting* – may involve removing paint and varnishes that contain lead

Drinking Water

Some water supplies contain lead. Water can also become contaminated with lead from older piping systems

Miscellaneous

- *Ceramics* – some ceramic bowls, mugs, plates, are glazed with lead-based glazes
- *Lead crystal* – some crystal contains lead that can leach into stored food or drink
- *Mini-blinds* – some mini-blinds contain lead
- *Candles* – some candles have leaded wicks
- *Folk remedies* – some folk remedies contain lead
- *Soil* – soil can pick up lead from exterior paint or past use of leaded gasoline in cars
- *Toys* – old toys may be painted with paint that contains lead

Take-Home Lead

Lead dust can be carried home from work on shoes, clothing, hair, skin, cigarettes, and other personal belongings. ***To prevent this***: store street clothing, shoes, and belongings in a clean place at work. Shower and change clothes before coming home. Wash your work clothes separately from other clothes.

Prevention

Some of the following precautions may help prevent lead poisoning from the sources listed above:

- Avoid hobbies/products with known lead hazards; choose lead-free substitutes
- Clean up all lead before it gets crushed into dust; use wet wiping/mopping methods
- Never use a regular vacuum cleaner, broom or compressed air to clean up lead
- Never remove paint containing lead; hire a licensed contractor
- Do not eat, drink, or smoke around lead
- Wash hands and face before eating, drinking, or smoking
- Have young children tested for lead even if they seem healthy; consult your local health department for details

www.state.nj.us/health/eoh/survweb

The Occupational Health Surveillance Program Home Page

...describes surveillance activities for:

- fatal occupational injuries
- heavy metals
- silicosis
- occupational asthma
- initiatives for prevention of latex allergy

... summarizes occupational disease reporting requirements for:

- hospitals
- laboratories
- physicians

... lists our publications (most are available on-line):

- educational materials
- industrial hygiene fact sheets
- FACE* investigations reports
- FACE Facts and Hazard Alerts
- list of articles published in peer-reviewed journals
- special surveillance reports

... and provides links to related sites.

*FACE (Fatality Assessment and Control Evaluation)

MARCUS INTERVIEW
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Q: *Case interviews conducted by Department staff often reveal that workers are seen by two, sometimes three, doctors before their illness is properly recognized. Why is this so?*
Marcus: A lot of this hassle can be avoided if a blood lead test, one of the most inexpensive clinical tests available, is ordered by the physician who sees the patient first. Our medical schools are remiss about teaching clinicians about occupational medicine. This type of training is critical since many cases with elevated BLLs show no symptoms or have symptoms that are unremarkable.

The primary care provider should always ask what a patient does for work and determine if the job involves risk of exposure to any toxic substance. We, unfortunately, have frequently been involved in caring for a patient with covert lead poisoning who has gone years being followed for a medical illness which was probably related to undisclosed lead poisoning. Such illnesses as hypertension and gout, particularly in the same individual, should prompt questions regarding environmental or occupational exposures.

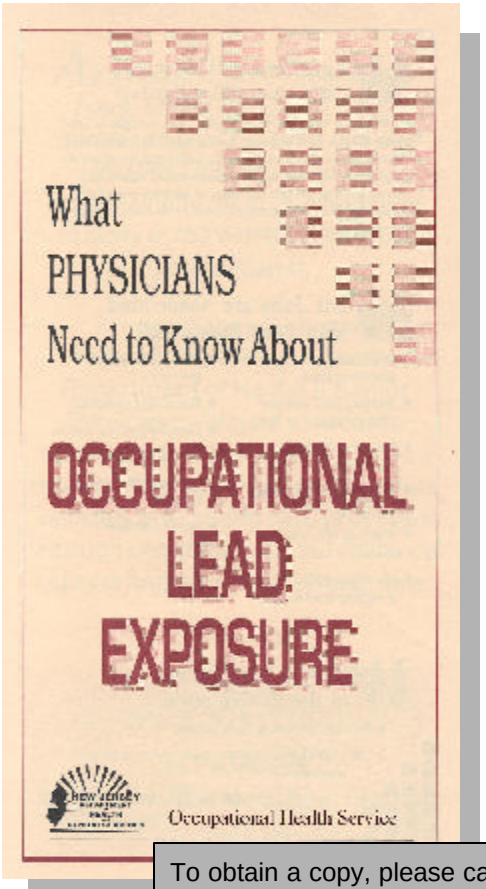
Q: *Are there any new medical developments in the treatment of adult lead toxicity, particularly in the area of chelation therapy?*
Marcus: First and foremost, the clinician must remember that primary prevention - preventing lead exposure, remains the key element in eliminating adult lead toxicity. Lead accumulates in the body over time with continued exposure. Chelation therapy should only be attempted after the worker is removed from exposure and compliance with medication insured. Chelation is potentially dangerous and may not change the long-term outcome in a given case. This is particularly true if any additional exposure occurs.

Although not approved for use in treating adult lead poisoning, Succimer (Chemet) is effective and reasonably safe if precautions are followed to avoid continued exposure.

Q: *Looking at ABLES data from 23 states including New Jersey, it looks like the number of workers with elevated blood lead levels and levels reported are decreasing nationwide? What are your thoughts on that?*
Marcus: It is reassuring that we see decreasing numbers. It is difficult, however, to know if overall there is a decrease in the number of affected individuals. We may have decreased the number of screened individuals but not the actual number of exposed individuals.

Q: *What was the most interesting case you've seen?*
Marcus: Actually, it was more than one case. It started out with a 2-year old child who was referred to us with an elevated BLL. It turned out that the child was exposed to take-home lead from his grandfather who worked in a scrap metal yard. Medical follow-up showed that his co-workers also had elevated BLLs. By the time the "dust settled," we had tens of children and adults in medical follow-up for their lead poisoning. The Department of Health also conducted an industrial hygiene workplace evaluation to address exposure issues.

Q: *Can New Jersey meet the "Healthy New Jersey 2010" objective for adult lead? (i.e., reduce to zero workers with occupational lead exposure causing BLL concentrations greater than 25mg/dl)*
Marcus: If the state is prepared to commit necessary resources to the ABLES Program, it is possible that this goal can be achieved. It is a formidable goal since the level is so far below the level (40 µg/dl) which triggers medical evaluation in the OSHA lead standards, and thus difficult to enforce. SU



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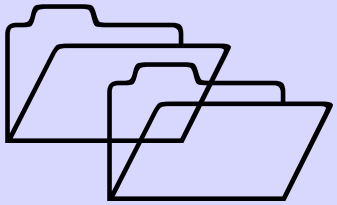

Adult Lead Poisoning

SELECTED REPORTS

Stained Glass Craftsman

A 52-year-old male was diagnosed with lead poisoning while working for a stained glass design company. He worked for this company for 25 years as a craftsman doing restoration of stained glass windows in churches and homes. He wore a dust mask during sandblasting. He never used nor was fitted for use of a respirator. The company did not provide work clothes, shower, or lunchroom. He smoked at his workstation. He learned about his elevated blood lead level (BLL) from the NJ Department of Health and Senior Services (DHSS). The company had not provided a pre-employment exam or routine physical exams. He went to his personal physician when he began to experience symptoms. His blood lead level was 58 micrograms per deciliter (µg/dl). The DHSS conducted an industrial hygiene evaluation and issued recommendations to the company concerning improvements of working conditions, exposure controls, and personal protective equipment.

Assembly Workers

A 27-year-old male and a 39-year-old female were diagnosed with lead poisoning while working for a battery manufacturing company. They were reported with BLLs of 53µg/dl and 56µg/dl, respectively. He worked for this company for six months and she worked for eight months on the assembly line. They were previously not exposed to lead. During their first months of employment the company did not provide them with respirators but requested later that they wear a half-face cartridge respirator. The company did not provide uniforms; they had to wash their clothing at home. They did not smoke or eat at their workstations. The workplace was dusty. One of the workers lived with a small child and was made aware of the risk of take-home lead exposure. DHSS issued recommendations to this company regarding improvement in engineering controls, personal protection, training, and work practices.

Renovation Worker

A 29-year-old, non-English-speaking male developed lead poisoning after being exposed to lead dust for approximately three months. He worked for a painting company removing lead-based paint from houses. Houses were enclosed with tents to prevent environmental contamination. He worked inside the tents wearing his own clothes. The company did not pay for laundering and did not provide respirators, a shower, or a lunchroom. He soon developed symptoms including unusual tiredness, frequent headaches, difficulty sleeping, irritability, and weakness and muscle pains in arms and legs. He suffered from constipation for 11 days and experienced stomach pains. All his symptoms were characteristic of lead poisoning. His BLL was 75.5 µg/dl. He was hospitalized, chelated and removed from lead exposure. The DHSS referred this painting company to OSHA for failure to implement DHSS recommendations concerning workplace practices and personal protective equipment.

Self-Employed Painter

A 33-year-old, non-English-speaking male developed lead poisoning following exposure to lead dust. He worked as a self-employed painter. He wore a surgical mask while removing the old paint. He did not know about respirators and thus never wore one. After two months of exposure his BLL rose to 141 micrograms per deciliter µg/dl. He developed symptoms such as irritability, muscle and joint pains, and stomach pains. He was hospitalized three times and chelated. After his last chelation and removal from lead exposure his blood lead level went down to 18 µg/dl.

Target Shooting

A 56-year-old retiree was diagnosed with lead poisoning because of his hobby. He was never exposed to lead in his previous jobs. This individual engaged in target practice for the last three years, a few hours a day. His physician was treating him because of other health problems. The physician requested that the patient discontinue target practice when he found out that his BLL was 73 µg/dl.

Auto Body Work

A 42-year-old male developed lead poisoning as a result of his hobby. He was exposed to lead fumes released while repairing old cars. The repair process involved welding. Because he developed symptoms, his personal physician requested a BLL test. His BLL was 73 µg/dl. He was chelated and advised not to perform welding while doing this type of auto body work.

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TABLE 1
Status of Lead Use In "Dropped Out" Workplaces by Industry, 2001*

Industry	Lead Use Status Code**						
	A	B	C	D	E	F	Total
Construction	1	2	5	2	11	1	22
Manufacturing	2	18		2	1	7	30
Chemicals and allied products	*1*	*7*		*1*		*4*	***13***
Rubber and miscellaneous plastic products						*1*	***1***
Stone, clay, glass, and concrete products		*2*					***2***
Primary metal industries		*2*			*1*	*1*	***4***
Fabricated metal products		*3*				*1*	***4***
Industrial and commercial machinery and computer equipment	*1*	*1*		*1*			***3***
Electronic and other electrical equipment & components		*3*					***3***
Non-Manufacturing	6	5	1		2	7	21
TOTAL	9	25	6	4	14	15	73

*excludes non-respondents, undeliverable and incomplete surveys
**Status Code: A=no longer using lead - B=air lead levels below OSHA action level - C=not in operation - D=one time use - E=temporarily not using lead - F=screening employees, blood lead levels below reportable level

companies. Completed surveys were returned by 73 companies (59%). Thirty-four companies (28%) did not respond, surveys were undeliverable to 13 companies (11%), and three surveys (2%) were returned incomplete. Table 1 summarizes the findings of the 73 completed surveys. The most frequent cause for dropping out of the Lead Registry was that lead air levels were below the OSHA action level and therefore these companies did not conduct biological monitoring on employees (25 companies, 34%). This was followed by companies (15, 20%) that conduct blood lead testing but all levels are below the laboratory reporting requirement of 25 µg/dl. Other reasons include 14 companies (18%) that did not use lead during this period, nine companies (12%) that no longer use lead, six companies (8%) no longer in operation, and four companies (5%) claiming a one time lead use. The two most common reasons identified in the manufacturing industry were air levels of lead below the OSHA action level (60%) and employee blood lead levels below the reportable level (23%). In non-manufacturing businesses such as radiator repair and law enforcement, the categories of "no longer using lead" (29%), air levels below the OSHA limit (24%), and blood lead levels below laboratory reporting requirements (33%) were the most common reasons for dropping out. In the construction industry, 50% of the responders were temporarily not using lead. Painting contractors involved in new construction painting is an example of a company that fits this description.

Companies are identified when clinical laboratories report elevated blood lead levels in adults to the ABLES program and these individuals are interviewed to determine where their lead exposure occurred. DHSS provides a variety of occupational health services to lead-using companies including telephone and on-site consultations, educational materials on lead, and on-site educational programs (See related article on page 4). These intervention activities are aimed at helping companies reduce workplace lead exposure and concurrently, the number of working adults with elevated blood lead levels. Follow-up to companies that are no longer identified in ABLES is useful in determining the effectiveness of our surveillance system. Companies that drop out because of reduced levels of exposure are a positive result of these surveillance-generated intervention activities. However, there is the possibility that companies have dropped out because of a tracking problem with the ABLES surveillance system. An employer may use an out-of-state laboratory that is not reporting to New Jersey. In the 1998 and 1999 "dropped out" surveys, five companies still testing their employees reported blood lead levels above 25 µg/dl, an indication of underreporting by laboratories.

The ABLES surveillance system relies on companies with lead exposure to test their employees blood lead levels. Companies that do not conduct biological monitoring prevent the State from tracking elevated blood lead levels. Continual follow-up of companies that have "dropped out" of ABLES is essential for an effective surveillance system. SU

Lead Resources

Work Safe!

Play Safe!

Stay Healthy!

NEW JERSEY DEPARTMENT of HEALTH and SENIOR SERVICES

New Jersey Department of Health and Senior Services

Occupational Health Surveillance Program

Tracks and follows up on workers with elevated blood lead levels reported under N.J.A.C. 8:44-2.11 and N.J.A.C. 8:57-3.2.
Phone: (609) 984-1863
Internet: www.state.nj.us/health/eoh/survweb
Publications:

- *What Workers Need to Know about Occupational Lead Exposure*
- *What Physicians Need to Know about Occupational Lead Exposure*
- *Don't Take Lead Dust Home from Work!*
- *Lead Exposure in General Industry (set of five fact sheets)*
- *Important Information for Contractors and Workers about Lead Paint Hazards*

Public Employees Occupational Safety and Health Program (PEOSH)

Enforces the OSHA lead standards for General Industry and Construction in the public sector and provides free on-site consultation services to public employers upon request.
Phone: (609) 984-1863
Internet: www.state.nj.us/health/eoh/peoshweb
Publications:

- *Facts about Lead Paint Hazards for Public Employees*
- *Lead Exposure in Construction (set of six fact sheets)*

Right to Know Program

Produces Hazardous Substance Fact Sheets (HSFS). Some are available in Spanish.
Phone: (609) 984-2202
Internet: www.state.nj.us/health/eoh/rtkweb
Publications:

- *HSFS for lead, lead acetate, lead arsenate, lead arsenite, lead azide, lead chloride, lead chromate, lead cyanide, lead dioxide, lead fluoborate, lead fluoride, lead iodide, lead nitrate, lead phosphate, lead stearate, lead subacetate, lead sulfide, lead sulphate, lead thiocyanate, tetraethyl lead, tetramethyl lead*

Lead and Asbestos Training Program

Certifies and performs oversight of agencies that train individuals seeking employment in the lead abatement and evaluation industry. Issues permit cards to qualified inspectors, risk-assessors, planner/project designers, workers, and supervisors under N.J.A.C. 8:62.
Phone: (609) 588-4573
Internet: www.state.nj.us/health/eoh/leadasb
Publications:

- *Renovation and Remodeling in Schools: You May Disturb Lead-Based Paint*
- *Lead-Based Paint Disclosure Takes Effect*
- *Lead in Mini-Blinds*
- *Lead in Playgrounds*

Indoor Environmental Health Program

Conducts field investigations on lead-based paint and other indoor environmental pollutants and contaminants. Provides education and outreach including consultation and technical assistance. Also handles issues related to school construction, Brownfields redevelopement and related activities.
Phone: (609) 588-3120
Internet: www.state.nj.us/health/eoh/tsrp

Child and Adolescent Health Program

Seeks to promote the optimum health and development of children and adolescents. Provides funding to local health departments and community-based organizations for preventive services, including childhood lead poisoning prevention under Chapter 13 of the State Sanitary Code.
Phone: (609) 292-5666 or (609) 984-0717. *Also contact your local board of health for specific information on screening services and other related activities.*
Internet: www.state.nj.us/health/fhs/chshome.htm
Publications:

- *Questions Parents Ask about Lead Poisoning*
- *Childhood Lead Screening Requirements*
- *Important Information for Homeowners and Renters about Lead Paint Hazards*
- *Childhood Lead Poisoning in New Jersey, Annual Report, Fiscal Year 2001*

New Jersey Department of Community Affairs

Lead Hazard Abatement Program

Enforces the New Jersey "Lead Hazard Evaluation and Abatement Code," N.J.A.C. 5:17, in all buildings and structures undergoing lead hazard abatement. Licenses lead evaluation and abatement contractors, conducts monitoring inspections and supports local building departments in the enforcement of lead hazard abatement rules.
Phone: (609) 984-7815
Internet: www.state.nj.us/dca/codes/forms/clc.htm

New Jersey Poison Information and Education System (NJPIES)

NJPIES is a statewide poison control center that handles emergency phone calls and provides information to the public. It is staffed by professionals specialized in poison control who are available 24 hours a day, 7 days a week.
Phone: 1-800-222-1222
Internet: www.njpies.org

New Jersey Department of Labor

- ***Occupational Safety and Health On-Site Consultation Program***

Provides NJ private sector employers with FREE consultations for a safe and healthy work environment for employees.
Phone: (609) 984-0785
Internet: www.state.nj.us/labor/consult.htm

- ***Division of Workers' Compensation***

Ensures that proper benefits are paid to workers who are injured on the job in addition to enforcing the law requiring employers to obtain insurance coverage for their employees.
Phone: (609) 292-2516
Internet: www.state.nj.us/labor/wc/Default.htm

University of Medicine and Dentistry of New Jersey (UMDNJ) - School of Public Health

Centers for Education and Training

Offers several continuing education courses on lead for inspectors, abatement workers, and supervisors.
Phone: (732) 235-9450
Internet: http://sph.umdnj.edu/ophp

Environmental and Occupational Health Sciences Institute (EOHSI)

As a joint institute of Rutgers, the State University of New Jersey and UMDNJ-Robert Wood Johnson Medical School, EOHSI sponsors research, education and service programs in a setting that fosters interaction among experts in environmental health, toxicology, occupational health, exposure assessment, public policy, and health education. It houses six divisions and numerous specialized centers.
Phone: (732) 445-0200
Internet: www.eoshi.rutgers.edu

New Jersey Department of Environmental Protection

- ***Bureau of Safe Drinking Water***

Enforces federal and state drinking water regulations and provides public water supply monitoring results.
Phone: (609) 292-5550
Internet: www.state.nj.us/dep/watersupply/safedrnk.htm

- ***Division of Solid and Hazardous Waste***

Advises how to dispose of lead-containing waste.
Phone: (609) 292-8341
Internet: www.state.nj.us/dep/dshw/

Legal Services of New Jersey

Provides free legal information, advice and referral to low-income residents on most civil legal problems in New Jersey. Information is also available on lead poisoning and legal rights.
Phone: (732) 572-9100
Legal Hotline: 1-888-LSNJ-LAW (1-888-576-5529) (Monday - Friday, 9:00 a.m. - 4:30 p.m.)
Internet: www.lsnj.org/hotline.htm
Publication:

- *Lead Poisoning: What It Is and What You Can Do About It*

... NATIONWIDE

U.S. Department of Labor

Occupational Safety and Health Administration (OSHA)

Enforces the OSHA lead standards for General Industry and Construction in the private sector.
Phone: (202) 693-1888
Internet: www.osha.gov
Publications:

- *Lead in Construction (Publication 3142)*
- *OSHA Lead Standard for General Industry, 1910.1025*
- *OSHA Lead Standard for Construction, 1926.62*

NJ OSHA Area Offices:

Avenel Office: Hunterdon, Middlesex, Somerset, Union, and Warren Counties, and Staten Island (NY) (732) 750-3270
Hasbrouck Heights Office: Bergen and Passaic Counties, (201) 288-1700
Marlton Office: Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Monmouth, Ocean, and Salem Counties, (856) 757-5181
Parsippany Office: Essex, Hudson, Morris, and Sussex Counties, (973) 263-1003

U.S. Department of Health and Human Services

- ***National Institute for Occupational Safety and Health (NIOSH)***

Coordinates the Adult Blood Lead Epidemiology and Surveillance (ABLES) program at the national level. ABLES is a surveillance system for identifying and preventing cases of elevated blood lead levels among U.S. adults.
Phone: 1-800-35-NIOSH
Internet: www.cdc.gov/niosh/ables.html
Publications:

- *Protecting Workers Exposed to Lead-Based Paint Hazards*
- *Report To Congress On Workers' Home Contamination Study*

■ ***Agency for Toxic Substances and Disease Registry (ATSDR)***

Develops a series of self-instructional publications designed to increase the primary care provider's knowledge of hazardous substances in the environment and to aid in the evaluation of potentially exposed patients. Continuing education courses for medical professionals are also available on the ATSDR web site.
Phone: 1-888-42-ATSDR (1-888-422-8737)
Internet: www.atsdr.cdc.gov/HEC/CSEM/
Publication:

- *Lead Toxicity - Course SS3059* (from the *Case Studies in Environmental Medicine* series)

Mount Sinai-Irving J. Selikoff Center for Occupational and Environmental Medicine and the Hunter College Urban Public Health Program

These two institutions collaborated to produce the publication listed below. They can be contacted for more information.
Phone: (212) 987-6043 for the Selikoff Center and **(**212) 481-8790 for Hunter College
e-mail: nancy.clark@mountsinai.org (Selikoff Center)
Publication:

- *Lead Control Guide for Bridges and Steel Structures: Protecting Workers During Rehabilitation and Demolition*

Center to Protect Worker's Rights

Works with construction unions to reduce health hazards, including lead.
Phone: (202) 962-8490
Internet: www.cpwr.com
Publication:

- *Lead Hazard Alert*

United States Consumer Product Safety Commission (CPSC)

The CPSC is an independent Federal regulatory agency that helps keep American families safe by reducing the risk of injury or death from unsafe consumer products. The CPSC also provides product recall information.
Phone: 1-800-638-2772
Internet: www.cpsc.gov
Publications:

- *CPSC Lead-in-Paint Activities Reduce Consumer Exposure to Lead*
- *Candles With Lead-Core Wicks Warning*
- *Don't Use Solder That Contains Lead For Work On Drinking Water Systems: Safety Alert*

U.S. Department of Housing and Urban Development

Office of Healthy Homes and Lead Hazard Control

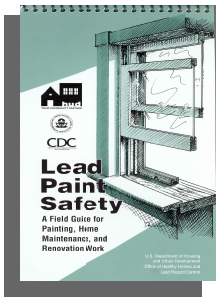
Provides information on lead abatement in the home.
Phone: (202) 755-1805
Internet: www.hud.gov/offices/lead
Publications:

- *Residential Lead Desktop Reference*
- *Tips for Parents: Simple Steps to Protect Your Family From Lead Hazards*

National Lead Information Center

The National Lead Information Center (NLIC) provides the general public and professionals with information about lead hazards and their prevention. NLIC operates under a contract with the U.S. Environmental Protection Agency (EPA), with funding from EPA, the Centers for Disease Control and Prevention, and the U.S. Department of Housing and Urban Development.
Phone: 1-800-424-LEAD (Monday - Friday, 8:30 a.m. - 6:00 p.m.)
Internet: www.epa.gov/lead/nlic.htm
Publications:

- *Lead Paint Safety*
- *Protect Your Family From Lead In Your Home*
- *Reducing Lead Hazards When Remodeling Your Home*



U.S. Environmental Protection Agency (EPA)

■ ***Office of Pollution Prevention and Toxics***

Provides information on all aspects of the Federal lead poisoning prevention program.
Phone: (202) 260-3810
Internet: www.epa.gov/opptintr/lead/index.html
Publications:

- *Lead Poisoning and Your Children*
- *Parents/Teachers/Day Care Providers/PTA Packet*
- *Lead in Your Home: A Parent's Guide*
- *Get the Word Out ... to Get the Lead Out!*
- *Keep it Clean: An Insider's Guide to Lead-Safe Painting and Home Improvement*
- *"Runs Better Unleaded" poster, brochure, tips cards, bookmarks*
- *Testing Your Home for Lead in Paint, Dust, and Soil*

EPA Region II Office:
Edison, NJ
1-888-283-7626

■ ***EPA Safe Drinking Water Hotline***

Provides answers to questions about lead in drinking water, including public drinking water standards.
Phone: 1-800-426-4791 (Monday - Friday, 9:00 a.m. - 5:30 p.m.)
Internet: www.epa.gov/safewater/pubs/lead1.html
Publication:

- *Lead In Your Drinking Water - Actions You Can Take To Reduce Lead In Drinking Water*

Lead adversely affects multiple organ systems including the central and peripheral nervous, hematologic (blood), cardiovascular (heart and veins), renal (kidneys), and reproductive systems.(1) Due to its unique physical and chemical properties, lead has widespread application in manufacturing and construction. Despite the fact that sources of lead exposure and effective preventive measures have been known for years, workers continue to be exposed to lead resulting in dangerously elevated BLLs.

The best diagnostic test for lead toxicity is the BLL test. The federal Occupational Safety and Health Administration's (OSHA) regulations to protect workers from lead toxicity include requirements for monitoring BLLs among employees who meet certain exposure criteria.

DHSS monitors the BLLs of adults through laboratory and physician reporting required by the following regulations:

- ***N.J.A.C. 8:44-2.11*** - Since 1985, laboratories have been required to report to the DHSS BLL greater or equal (≥) 25 µg/dl in adults (17 years of age and older). However, since 1998, laboratories are required to report *all* BLLs in adults.
- ***N.J.A.C. 8:57-3.2*** - Since 1990, physicians are required to report to the DHSS lead toxicity in adults defined as BLL ≥25 µg/dl. (see page 27 for more information)

FIGURE 1
Distribution of Cases by Source of Adult Lead Exposure
New Jersey, 1986 - 2000
N = 5,904

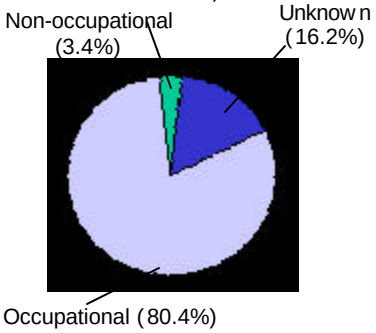


TABLE 1
Work-related Reports (BLL ³ 25 µg/dl)
New Jersey ABLES Reporting Trends: 1986 - 2000

Year	# of Reports	# of Cases[1]	# of New Cases[2]	# of Workplaces[3]	# of New Workplaces[4]
1986	1,124	687	619	95	79
1987	687	415	227	95	41
1988	1,927	951	671	123	54
1989	4,294	1,054	474	126	57
1990	4,134	1,154	465	118	41
1991	3,255	881	271	112	33
1992	1,964	724	261	119	49
1993	1,831	704	308	108	30
1994	1,769	644	225	98	24
1995	1,280	547	181	98	28
1996	1,190	535	220	123	35
1997	1,424	521	186	104	33
1998	1,345	456	137	98	26
1999	1,474	471	196	101	36
2000	1,254	532	206	95	27
TOTAL	**28,952**		**4,748[5]**		**612[6]**

[1] Number of cases per year (counted once each reported year)
[2] Number of new cases first identified (counted only once between 1986-2000)
[3] Number of workplaces with known SIC codes per year (counted once each reported year)
[4] Number of new workplaces first identified (counted only once between 1986-2000)
[5] Includes 101 individuals first identified in 1985 with BLL reports in subsequent years
[6] Includes 19 workplaces first identified in 1985

Reporting to the DHSS of elevated BLLs in adults by laboratories and physicians has led to a variety of intervention activities to prevent workplace lead exposure and its adverse effects. Industrial hygiene evaluations and on-site consultations are conducted at lead-using work sites. Employers that exceed certain criteria are referred to OSHA. Educational materials are provided to reported individuals, their physicians, and their employers. Workers with high BLLs are referred to physicians for clinical follow-up. Targeted outreach is conducted in high-risk industries. A series of reports (2), (3), (4) (5) (6) using surveillance data on adult lead exposure has been published by DHSS to assist occupational health practices in developing public health priorities and prevention programs.

Reported Individuals

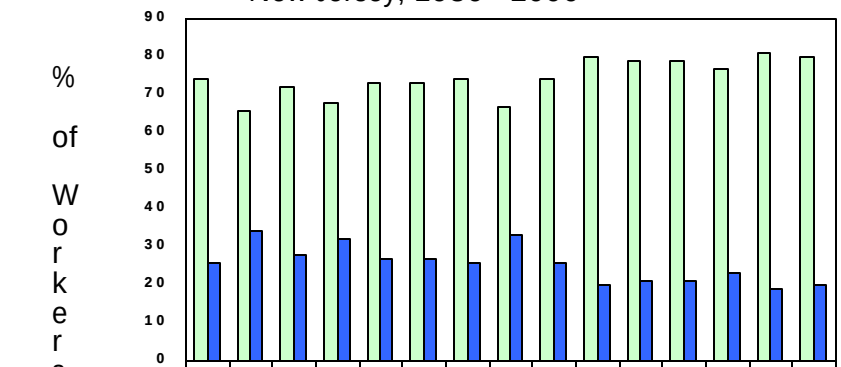
From January 1, 1986, through December 31, 2000, DHSS received and processed a total of 30,820 reports of adult BLL ≥25 µg/dl on 5,904 individuals from clinical laboratories and physicians. In terms of the source of exposure, 700 reports on 202 individuals were non-occupational; for 1,168 reports on 954 individuals the exposure source was unknown; and 28,952 reports on 4,748 individuals were determined to be work-related (Figure 1).

Work-related Reports

Table 1 (previous page) presents the number of occupational reports, workers, newly identified workers, and workplaces identified from these reports. Reported individuals and workplaces were counted once each year they were reported. The same workplace and the same individual may be counted again in subsequent years. New cases were counted only once, in the year they were first identified.

The highest number of reports was recorded in 1989, the lowest in 1987. The number of new reported individuals was highest in 1988, declining until 1995 followed by minor fluctuations in later years. At least 25% of all workplaces identified annually are new to the ABLES system.

FIGURE 2
ABLES Reporting Trends
Distribution of Workers (percent)
by Blood Lead Level Group
New Jersey, 1986 - 2000



	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00
Below 40 µg/dl	74	66	72	68	73	73	74	67	74	80	79	79	77	81	80
>= 40 µg/dl	26	34	28	32	27	27	26	33	26	20	21	21	23	19	20

Trends in Blood Lead Levels

Figure 2 displays the annual number of workers by peak BLL in two groups - those with peak BLL less than 40 µg/dl and those with peak BLL ≥40 µgdl. The proportion of workers with peak BLL <40 µg/dl has been 66 percent or higher throughout this period. For the proportion of workers with peak BLL ≥40 µg/dl, a maximum of 34 percent was observed in 1987 with another peak of 33 percent observed in 1993, associated with the increase in reporting for workers in the construction industry, and falling to 20 percent in the most recent year.

TABLE 2
Workplaces and Workers by Industry*
New Jersey, 1986 - 2000

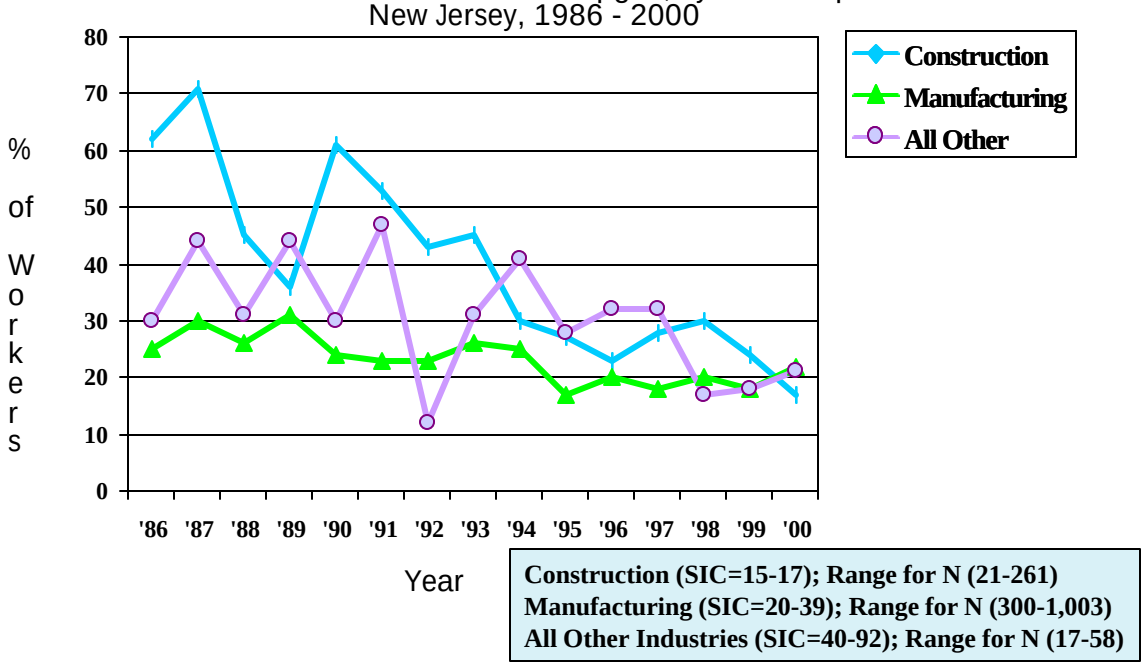
SIC** Code	Industry	# of Workplaces	# of Workers
15-17	Construction	266	1,238
28	Chemical and allied products	45	796
30	Rubber and miscellaneous plastics products	8	51
32	Stone, clay, glass and concrete products	25	320
33	Primary metal industries	43	960
34	Fabricated metal products	14	84
35	Industrial and commercial machinery	13	52
36	Electronic and other electrical equipment	17	822
48	Communication	5	11
50	Wholesale trade-durable goods	22	79
75	Automotive repair, services, and parking	30	55
	All other SIC codes	115	233
	Work sites with unknown SIC code	9	16
TOTAL		**612**	**4,748**

*excludes 31 individuals with unknown workplaces
**Standard Industrial Classification

Industry Classification

Workplaces identified from case reports are classified by industry type using the Standard Industrial Classification (SIC) codes. Table 2 presents the distribution of all cases and workplaces counted once. It excludes 31 individuals of occupational exposure where the SIC code of a workplace could not be identified. The construction industry predominated, with 43 percent of the workplaces and 26 percent of the workers. In the manufacturing industry group, primary metals and chemical and allied products together accounted for 37 percent of the workers and 14 percent of the workplaces. Figure 3 shows the proportion of individuals with BLL ≥40 µg/dl across three categories: construc-

FIGURE 3
Proportion of Workers with
Peak Blood Lead Level ≥ 40 µg/dl, by SIC Group
New Jersey, 1986 - 2000



Construction (SIC=15-17); Range for N (21-261)
Manufacturing (SIC=20-39); Range for N (300-1,003)
All Other Industries (SIC=40-92); Range for N (17-58)

tion, manufacturing, and all other industries. The construction industry displays the most dramatic change, showing a reduction of individuals with BLL ≥40 µg/dl from 70 percent in 1987 to 17 percent in 2000. In 1987, there were 21 workers reported from the construction industry. However, the number of workers reported increased in subsequent years, reaching a maximum of 261 in 1993 and decreasing to 144 in 2000.

Several factors may have contributed to the changes in the construction industry. These were: the inclusion of lead safety contract language for bridge construction contractors by the New Jersey Department of Transportation in 1992, the implementation of the OSHA lead in construction standard promulgated in 1993, and a licensing requirement of lead abatement workers and certification of lead abatement contractors by the New Jersey Department of Community Affairs in 1996.

In the manufacturing sector, a peak of 31 percent of workers was observed in 1989, followed by a steady decline until 1995, with a slight increase in later years. The decrease may be due to the decline in employment in manufacturing industries in New Jersey and changes in manufacturing processes, resulting in lead not being used or workers not being exposed.

For the third category, all other industries, there were wide variations in the proportion of individuals with peak BLL ≥40 µg/dl. A maximum of 47 percent was observed in 1991, falling below 20

Lead-based paint is a hazard if it is peeling, chipping, chalking, or cracking.

percent in 1998 and 1999, and increasing to 21 percent in 2000.

Discussion

Among individuals reported each year, more than 30 percent are new to ABLES. For reported workplaces, more than 25 percent are new each year. New individuals require follow-up (see related article on page 4) to determine the source of exposure — occupational or non-occupational. New workplaces, when identified, require follow-up as well (see related article on page 6). The DHSS encounters major problems with incomplete data received from reporting laboratories, similar to the experience of other ABLES states. Monthly, the ABLES staff make many phone calls to laboratories and physicians to retrieve missing information that is essential for efficient follow-up of lead-exposed individuals, their employers, and their physicians. Laboratories often indicate that physicians do not provide these essential data. In the most recent five-year period there is a reduction in the number of individuals reported with BLL $\geq$ 40 µg/dl, in addition to a a reduction in the number of new cases. The observed decline in the proportion of workers with BLL $\geq$40 µg/dl is an encouraging shift in the right direction.

With the recent implementation of universal reporting in New Jersey, over 4,000 reports of BLL below 25 µg/dl were received during the second half of 1999. Future implementation of electronic data transfer of BLL results from major clinical laboratories will facilitate more efficient analysis of these reports. DHSS expects that electronic data transfer will also significantly reduce the number of laboratory reports having incomplete information.

Conclusion

The ABLES system, despite some limitations, provides valuable information about occupational lead toxicity in New Jersey. While some lead-using businesses have closed, new workers and workplaces are being identified each year. Continued surveillance and intervention efforts are essential to educate new employers and new workers, as well as to reinforce hazard reduction among those currently using lead.

– *Partnerships*

Intra- and inter-agency cooperation provides another avenue to extend the prevention efforts by DHSS. Using OSHA's enforcement action selectively through OSHA referrals has resulted in the effective deployment of resources for both agencies. A cooperative project with the New Jersey Department of Community Affairs helped to reach out to employers and employees engaged in lead abatement in non-residential buildings (See February 2001 issue of the *Update*). In terms of preparing for electronic data transfer, ABLES staff worked with the DHSS Childhood Lead Poisoning and Prevention Program (CLPPP). CLPPP receives all BLLs from laboratories that report electronically, separates those for adults, and forwards them to the ABLES project. BLL reports of out-of-state workers, or from out-of-state workplaces, are referred to the appropriate state ABLES program for follow-up. ABLES personnel work with NIOSH to organize panel discussions or give presentations at national meetings to disseminate surveillance information.

Workers removing lead-based paint from an overpass over the New Jersey Turnpike.

– *"Healthy New Jersey 2010"*

The *"Healthy New Jersey 2010"* objective for occupational lead exposure is a reduction to zero of the number of workers with occupational lead exposure causing BLL concentrations ≥25 µg/dl. Intervention activities in all lead-using workplaces, where workers are reported with BLL's ≥ 25 µg/dl, should help in meeting this goal. Education of employers and employees about the hazards of lead exposure and control measures will supplement industrial hygiene services. It is expected that the implementation of electronic data transfer will help to quickly identify new workplaces because the name of the employer is often missing from BLL reports. Universal reporting will assist in evaluating DHSS intervention strategies in reducing BLLs below 25 µg/dl. These changes, together with continued surveillance and prevention efforts, are necessary to minimize occupational lead exposure and achieve the stated goal. SU

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2. Gerwel B, Ramaprasad R, Stanbury M. Surveillance of Occupational Lead Exposure in New Jersey: 1985-1991. New Jersey Department of Health. January 1993.

3. Gerwel B, Stanbury M. Adult Blood Lead Epidemiology and Surveillance in New Jersey: 1992-1993. New Jersey Department of Health. May 1995.

4. Gerwel B, Pearson M, Ramaprasad R, Stanbury M, Valiante D. Adult Blood Lead Epidemiology and Surveillance in New Jersey: 1986-1996. New Jersey Department of Health. May 1998.

5. Valiante D, Rab S, Stanbury M. Lead Hazard Surveillance Using an Environmental Reporting Database. Appl Occup Environ Hyg 1997; 12(11) 769.

6. Roche L, Ramaprasad R, Gerwel B, Pearson M, Valiante D, Stanbury M, O'Leary K. Evolution of a State Occupational Lead Exposure Registry, 1986-1996. J Occup Environ Health 1998; 40:1127-1133.

Lead-based paint deterioration on the Ben Franklin Bridge over the Delaware River.

Occupational Health Surveillance Update

A newsletter of the Occupational Health Surveillance Program, Occupational Health Service (OHS), Division of Epidemiology, Environmental and Occupational Health, New Jersey Department of Health and Senior Services.

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Current … NEWS Issues LEAD SURVEILLANCE …

NewYork State ABLES

Program has had 37 individuals reported with elevated blood lead levels (BLL) since 1984 due to retained bullets or shot. BLL results have shown that as many as 20% of these individuals have had BLLs greater than 60 micrograms per deciliter (µg/dl) and 13% between 40 and 59 µg/dl.

Physicians who work in prisons or who have treated war veterans are familiar with such cases of lead poisoning. Although there are many cases reported in the literature, there have been few studies conducted on this subject. Review of three studies points to five risk factors for toxic effects: 1) bullet/fragment location – contact with synovial fluid in a joint; joint motion and friction; 2) lead surface areas – multiple fragments have larger surface area for increased exposure; 3) duration of exposure to bullet or fragment; 4) type of bullet and lead content; 5) individual hyper-metabolic state may mobilize lead sources.

Source: from a discussion on Occ-Env-Med-L, the free electronic international forum in Occupational & Environmental Medicine, at http://occhealthnews.net

GUIDELINES

NIOSH and various states, including New Jersey, formed a committee to develop national adult blood lead level (BLL) medical management guidelines similar to the CDC's childhood guidelines. The adult blood lead guidelines are intended for health care providers, clinical laboratories, the lead industry, and others involved in the prevention of lead toxicity among exposed adults. The guidelines will provide information on: lead toxicity, occupational and non-occupational sources of lead exposure, federal OSHA lead standards, clinical tests and levels, laboratories approved by OSHA, medical management of lead toxicity, state reporting requirements, employer and health care provider responsibility, schedules for medical services, and a resources section.

A one-page addendum for laboratory use in reporting BLLs to clinicians will be developed to assist clinicians and others to improve accuracy and uniformity of interpretative information on laboratory BLL results.

For more information, contact Karen Hipkins at khipkins@dhs.ca.gov.

CSTE Passes Position Statement

The Council of State & Territorial Epidemiologists (CSTE) has adopted a position statement aimed at petitioning Federal OSHA to update its standards for the protection of workers exposed to inorganic lead, 29 CFR 1910.1025 (general industry) and 29 CFR 1926.62 (construction).

Based on the experience of the ABLES program, state-based health professionals have become keenly aware of needed improvements in OSHA's lead standards that should be addressed by initiating a rulemaking process to update them. Individuals or organizations may petition OSHA for new rulemaking under section 6(b)(1) of the Occupational Safety and Health Act of 1970.

Position statements provide programmatic guidance and influence public health policies on national, state, and local levels. Position statements are introduced and adopted at CSTE annual meetings. Position statements are developed by CSTE and are an integral part of the work performed by its members. The national office distributes the statements, calls for comments, and organizes the responses. The national office also tracks the statements to ensure the issues/solutions raised in the position statements are considered, if not implemented.

For more information on this position statement, please visit www.cste.org/ps/2001/2001-occ-01.htm

Normal Values for Blood Lead

As in New Jersey, laboratories in Michigan are required to report the results of all blood lead tests. The best data for assessing what is normal background level for lead comes from the National Health and Nutrition Examination Surveys, which is an ongoing program of the National Center for Health Statistics. This program performs medical examinations and testing on a random sample of the United States population and generates "normal" values for many different parameters. In children and adults all but five percent of the population has a blood lead level (BLL) less than 10 micrograms per deciliter (µg/dl). The Centers for Disease Control & Prevention (CDC) has not developed management guidelines for lead for adults. This lack of guidance is reflected in the normal range that laboratories report for adults. Any BLL above 10 µg/dl indicates exposure beyond that expected in the general population. Because lead accumulates in the body, exposure leading to BLL $\geq$10 µg/dl increases the risk for developing adverse health effects. Based on these findings, the Michigan ABLES Program has gained the cooperation of local clinical laboratories to change their upper limit of normal for BLL to 9 µg/dl for individuals of all ages.

In New Jersey, some laboratories use the same normal range for adults as for children, while others indicate normal level up to 25 µg/dl. In the past, some laboratories in New Jersey indicated normal BLL up to 40 µg/dl, which triggers OSHA requirements for medical evaluation of exposed workers.

Source: Adapted from *Project S.E.N.S.O.R. News,* Michigan State University, Volume 12, No. 2, Spring 2001

New ABLES Funding

The Centers for Disease Control and Prevention (CDC) - National Institute for Occupational Safety and Health (NIOSH) is providing approximately $900,000 in Fiscal Year 2002 for Adult Blood Lead Epidemiology and Surveillance programs in states that have mandatory statutes for the reporting of adult blood lead levels (BLL) by laboratories. The New Jersey Department of Health and Senior Services is one of 35 states awarded a 12-month contract within a project period of up to 4 years. Eleven variables are required to be submitted to NIOSH for full funding including BLL results, biographical data on reported individuals, and occupational source of lead exposure. Data from all laboratory reports for individuals (16 years and older) with a BLL equal to or greater than 25 µg/dl are combined with data from other ABLES states, analyzed by NIOSH, and published quarterly in CDC's *Morbidity and Mortality Weekly Report.*

Paint Manufacturers Face Legal Suits

In a legal action similar to the recent suit filed by individual states against the tobacco industry, a number of public jurisdictions around the country are suing the lead paint industry over the child lead poisoning problem. Among them are Newark, Rhode Island, St. Louis, New York City, Milwaukee, and several counties and cities in California, including San Francisco and Oakland. Chicago has announced its intention to file suit, and in Massachusetts there is now an organized effort to convince the Attorney General to do so. In general, plaintiffs seek both reimbursement for past lead poisoning-related expenses and funds to abate lead paint hazards to prevent future lead poisoning. For more details, visit the websites of the Alliance to End Childhood Lead Poisoning (www.aeclp.org).

IPPOLITO INTERVIEW
Continued from page 3

Overall progress to date has been good. The number of notifications received by OSHA alleging elevated blood lead levels (BLLs) in workers greater than 50 micrograms/deciliter (µg/dl), especially involving bridge painters, has steadily dropped over the past eight years. Additionally, the number of citations written by the New Jersey area offices for lead overexposures in general industry has dropped steadily over the last 10 years.

Because exposures in some industries were so high in the past, the primary role of OSHA in New Jersey was to prevent lead poisoning and therefore by association, the worst occupational exposures. To that end, I believe OSHA has been very successful. A secondary goal is the elimination of all exposures that could lead to increased biological absorption and the insidious harm associated with these exposures. This goal is more lofty and yet I do believe that it is within reach. I am confident that through continued strong enforcement of the OSHA standards, employer education, and creative partnerships involving DHSS and other stakeholders, the levels of occupational lead exposure will continue to drop in the future.

Q: *What is the role of the employer in preventing occupational lead poisoning?*
Ippolito: On this issue, OSHA's view is simple. The employer has the primarily responsibility for ensuring that its workers are not excessively exposed to lead from all routes of entry into the body. OSHA's standards mandate that wherever lead is used or is present and poses a potential risk to employees in the workplace, the employer must follow, as a ***minimum***, the applicable OSHA standard, 29 CFR 1910.1025 for general industry, or 29 CFR 1926.62 for exposure during construction, demolition and renovation activities.

Both standards have the same format and include the following general requirements. The extent of the requirements vary directly with the degree of the exposure and they include:

- employer assessment of the exposure
- training of employees on the standard and on the hazards of lead
- providing personal protective equipment
- providing respiratory protection equipment
- providing engineering controls such as local exhaust ventilation to eliminate lead exposure at the source
- providing medical surveillance for exposed employees
- removing employees from exposure when BLLs exceed 50 µg/dl
- providing benefits for employees removed from exposure
- periodic airborne assessments of exposure
- providing periodic biological monitoring of employees to assess the effectiveness of the program
- recordkeeping to track the above
- notifying employees in writing of their lead exposures
- notifying employees in writing of their blood lead and zinc protoporphyrin (ZPP) levels
- providing facilities for washing and showering
- providing facilities for eating in a lead-free environment.

The employer's role also includes work rule enforcement. This means that the employer who properly trains and equips employees to work safely with lead must also ensure that they follow the work rules instituted to reduce lead exposure. The employer should document its efforts to ensure compliance.

Q: *What exposures to lead do you see decreasing in New Jersey?*
Ippolito: I believe that lead exposures in general are declining industry-wide throughout New Jersey. As I mentioned above, those exposures that do remain are being better controlled. This opinion is based upon various statistics particular to OSHA enforcement activities that provide an indirect index of occupational lead exposure. For example, from 1989 to 1994, the OSHA offices in Region II, which includes New Jersey, New York, Puerto Rico, and the Virgin Islands, issued 47 citations for overexposure to lead in general industry. From 1995 through 2001, only 23 citations were issued. In the construction industry, the data show that more overexposures were found for the same time periods. I believe that the main reason for the difference is the more recent effective date of the lead in construction standard. It has only been in effect for eight years vs. over 20 years for OSHA's general industry lead standard. I strongly suspect that in the next five years, the trend for these citations will also be downward. One important reason for the reduction in employee exposures, as it directly affects employees in manufacturing and as it subsequently affects workers in construction, is the EPA ban on lead in most paints and coatings that took effect in the late 1970s.

Up until about five years ago, the bridge painting industry was notori-

ous for uncontrolled lead exposure leading to extremely high BLLs. However, in 1992, the DHSS, the New Jersey Department of Transportation, and OSHA worked in partnership to institute comprehensive contract language that required specific safeguards to prevent excessive lead exposure. This language continues today without modification. The specificity and completeness of these requirements ensured that bridge painting contractors could no longer claim ignorance about what they needed to do to prevent lead poisoning. The language requires, among other things, that the contractor hire a health professional to oversee its on-site compliance, that employees be provided with once a month blood leads, and that a full written compliance plan, called a Lead Health and Safety Plan (LHSP), be written and implemented. Through the 1990s, the combination of strong enforcement by OSHA and the "no-escape" contract LHSP language forced this industry to change. Throughout this past decade, the result has been a steady decline in worker BLLs.

This language was also a victory for the employers. It had the effect of "leveling the playing field" for all contractors who bid on such jobs. Thus, those employers who made the effort and spent the money to protect their employees would now be able to compete and not be under-bid for work.

In the manufacturing industry, the production of lead-acid batteries was an industry in which lead exposures were extremely high. Over the last 20 years, the exposures have decreased dramatically. We know this because both BLLs and large penalty citations, so common 10 or 15 years ago, have declined.

Q: *What are the most common citations issued to lead-using workplaces in New Jersey?*
Ippolito: The most common citation issued for lead exposure in general industry is for failure to train employees about the hazards of lead, 29 CFR 1910.1025 (l). The second most common citation issued by OSHA addresses the employer's failure to conduct airborne sampling for lead to assess employee exposure, 29 CFR 1910.1025 (d). These standards are commonly cited because both requirements apply even when airborne levels of lead are below the permissible exposure limit.

In construction, the most common citation addresses the lack of employee training and personal and respiratory protection supplied or used by employees performing tasks known to produce high airborne lead exposures, such as dry scraping, power sanding, torch cutting, and abrasive blasting. This requirement is found in 29 CFR 1926.62 (d).

Q: *What can employers do to eliminate these problems?*
Ippolito: Very simply, comply with OSHA's regulations listed above. Specific questions about how to comply in certain situations can be answered by any of the Area Offices. Additionally, ***on-site help*** can be obtained ***free of charge*** and ***free of citations*** by calling the New Jersey Department of Labor's Occupational Safety and Health On-Site Consultation program at (609) 984-0785.

Q: *What was your most unusual inspection of a lead-using workplace?*
Ippolito: I have been involved with several memorable inspections involving lead. The one that sticks out in my mind above the rest involved a bridge painting contractor who came to my office to argue about the citations he received. The conditions found at his job site were horrendous and several employees were exposed to massive air lead levels without adequate protection. Conditions included employees conducting abrasive blasting inside the enclosure with airborne lead levels over 50,000 μg/m^3 *(1,000 times the OSHA PEL of 50 mg/m^3)!* Employees were protected only with a paper dust mask and an abrasive blasting helmet that was not connected to an air supply. Employees ate their lunch right in the lead dust. Wipe samples revealed lead levels on the back of their hands in the *milligram* range. None of the employees had the slightest idea about their lead exposure and OSHA became aware of the problem only when the doctor of one of the workers called. They all had BLLs over 70 μg/dl and had been on the job only for about two weeks. The only "control" that the employer insisted upon was to have his employees drink a pint of milk at the end of each shift. Needless to say, this was not effective.

During a meeting with the owner to discuss the citations that were issued, I noticed a visible and uncontrollable shaking of his hands. He looked gaunt and frail and seemed unable to focus his thoughts very well. As part of the negotiated settlement of the citations which required that all of his employees see a physician immediately, I was also able to convince the owner to see his own doctor.

It was about a month later that I was informed that he had a BLL of 107 μg/dl, a ZPP over 300, and had

suffered permanent nerve damage. Ultimately, he had to retire and sell his business.

Q: *What are some creative ways of controlling or eliminating lead in industrial applications?*
Ippolito: In my experience I have found no easy way to effectively reduce lead levels. It almost always requires solid industrial hygiene and engineering controls.

The most effective way I've seen to control lead exposure is to *eliminate* its use. For example, as bridges in New Jersey get re-painted, the new paint does not contain lead. Paint chemistry has advanced where the corrosion resistance once found only with leaded paint can be achieved using substitutes. Also, due to changes in the building codes, leaded solder is no longer used in drinking water systems.

Q: *ABLES data from 27 states including New Jersey show that the number of workers with elevated BLLs is decreasing nationwide. What are your thoughts on that?*
Ippolito: I reviewed the data and I agree that there is an apparent decline in elevated BLLs nationwide. However, the word "elevated" is a relative term. "Elevated" has different meanings for different individuals and for the same person under different circumstances. I would certainly agree that the percentage of workers suffering the very highest BLLs, such as those greater than 50 µg/dl, has decreased.

OSHA has had an important role in reducing employee lead exposures. However, there is more work to do and OSHA needs the help of employers, stakeholders, and partners to continue the job. SU

Lead Abatement Clean-up -- Does it Work?

The New Jersey Department of Health and Senior Services (DHSS) recently completed a research study entitled, "An Evaluation of Lead-Based Paint Abatement Clean-up and Clearance Methodologies." The study was conducted by the Consumer and Environmental Health Services (CEHS) with funding from the U.S. Department of Housing and Urban Development (HUD). The purpose of the study was to evaluate cleaning and clearance work practices currently utilized by certified lead abatement contractors. Data were collected from typical, single- and multi-family housing units undergoing comparable interior lead abatement work. In any lead abatement project, the final cleaning procedures represent one of the critical operations before occupants return to the unit. HUD Guidelines outline a series of clean-up procedures that have been shown to be effective for removing leaded dust. The procedures are also required in New Jersey's lead abatement regulations. The three-step cleaning process involves: 1) HEPA (High Efficiency Particulate Air) vacuuming of work area, 2) wet washing/wiping with specific detergent or trisodium phosphate, and 3) HEPA vacuuming after drying.

Primary Objectives

- To evaluate and describe the efforts necessary to achieve clearance following lead hazard abatement activities;
- To evaluate the spatial deposition of lead dust on dwelling floors following lead abatement and clean-up procedures, and;
- To evaluate and compare the analytical results using portable Anodic Stripping Voltammetry (ASV) technology with results obtained from a certified laboratory.

Results

- Field cleaning methods employed by the contractors deviated considerably from HUD recommended procedures;
- Walls and ceilings of the work area were not cleaned in 83% of the sites;
- HUD recommended 3-bucket wet wash method was not followed in 80% of the sites;
- The three-step cleaning process did not consistently produce a 100% clearance rate;
- All sites that had a rough floor surface failed HUD clearance standards;
- There was significant variation in the distribution of floor lead dust levels during clearance testing.

These data suggest that the lead abatement industry may need to improve compliance in regard to proper cleaning requirements. Other findings suggest that a floor dust sample taken from a high traffic area in the room may be the most representative. The evaluation to compare the analytical results using portable ASV technology with the results obtained from an accredited laboratory was inconclusive. CEHS is continuing its evaluation of the lead abatement cleaning procedures in a follow-up study that is currently underway.

For further information, contact CEHS at (609) 588-3120 or visit their website at www.state.nj.us/health/eoh/trsp for a copy of the Executive Summary of the study. SU

Reporting Requirements for Adult Lead Toxicity

The reporting of adult lead toxicity and other occupational diseases and injuries to the New Jersey Department of Health and Senior Services (DHSS) triggers follow-up with the reported individual and action to ensure that their co-workers are not also at risk. Such reporting is a very important disease prevention public health activity and is required by the regulations described below.

Laboratories

N.J.A.C. 8:44-2.11
Reporting by laboratory supervisors

Results of laboratory tests on adults indicating elevated levels of lead, mercury, arsenic, or cadmium in blood or urine are required to be reported immediately by laboratory supervisors to the DHSS. The report should include complete information on the person with the elevated result, including the name and address of their employer. The report should also include the name of the attending physician and the date of the test. Reporting levels are as follows:

a. **lead in blood: any level**
b. **lead in urine: ≥ 80 µg/L**
c. mercury in blood: ≥ 2.8 µg/dl
d. mercury in urine: ≥ 20 µg/L
e. arsenic in blood: ≥ .07 µg/ml
f. arsenic in urine: ≥ 100 µg/L
g. cadmium in blood: ≥ 5 µg/L of whole blood
h. cadmium in urine: ≥ 3 µg/gram creatinine

Physicians

N.J.A.C. 8:57-3.2
Reporting of occupational and environmental diseases and injuries by physicians

Certain diagnoses in adults are required to be reported to the DHSS within 30 days after diagnosis or treatment. The report should include complete information on the person diagnosed with such a disease, including the name and address of their employer. The report should also include the name of the reporting physician and the date of onset of illness or injury.

Reportable diagnoses include **lead toxicity, adult (defined as blood lead greater or equal to 25 micrograms per deciliter; urine lead greater or equal to 80 micrograms per liter)** and other work-related diseases and injuries. A complete list of other reportable conditions are listed in the text of the regulation.

Reporting forms and a copy of the regulations are available by calling
(609) 984-1863
or via e-mail at *surveillance@doh.state.nj.us*

Occupational Illness and Injury Reporting to the New Jersey Department of Health & Senior Services

Condition	Number of New Individuals Reported											
	From beginning of reporting through 1990	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	Cumulative Total
Fatal Injuries [2]	993	112	138	145	114	118	99	101	103	103	115	2,141
Occupational asthma [3]	143	66	47	70	41	57	39	72	22	9	8	574
Silicosis [4]	810	74	46	46	26	25	47	43	40	34	30	1,221
Other pneumoconioses [5]	3,444	609	676	624	474	655	611	498	417	1,609	1,581	11,198
Acute lung conditions [5]	540	76	65	75	57	68	82	59	32	140	132	1,326
Chemical poisonings [5]	1,399	293	217	207	141	216	150	129	145	289	204	3,390
Elevated blood lead levels [6]	2,557	271	261	308	225	181	220	186	137	196	206	4,748
Elevated blood and urine mercury levels [6]	295	55	24	17	24	23	34	11	35	20	33	571
Elevated blood and urine cadmium levels [6]	227	17	2	16	14	30	17	18	16	9	24	390

1 Includes confirmed and unconfirmed workers.
2 Data sources: death certificates, medical examiners' reports, OSHA, workers' compensation reports, Fatal Accident Reports, news clippings. Reporting began in 1983.
3 Data sources: physicians, hospital reports. Reporting began in 1988.
4 Data sources: hospital reports, physician reports, death certificates. Reporting began in 1979. Incomplete reporting from hospitals in 1993 and 1994.
5 Data source: hospital reports. Reporting began in 1985. However, starting in 1999, reporting changed to electronic hospital discharge data; cases from previous years may be included.
6 Data sources: physicians, laboratory reports. Reporting began in 1985.

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